REMARKS/ARGUMENTS

All previously-pending claims have been cancelled in favor of the newly-submitted claims 21-26. Applicant submits that these new claims patentably define over the known prior art, including the art most-recently cited by the Examiner, and that the claims are in condition for allowance.

New Claims

New claim 21 recites a non-reciprocating electric motor, and a reciprocating pump operatively connected to the non-reciprocating motor for being driven by the motor. As claimed, the non-reciprocating motor has a metal housing assembly having first and second ends, a metal first bearing mounted in the housing, the first bearing having a plurality of rolling elements positioned between first inner and outer races, and a metal second bearing mounted in the housing and spaced away from the first bearing. The second bearing has a plurality of rolling elements positioned between second inner and outer races. A metal rotor assembly is provided, and includes a metal shaft having first and second ends mounted in the first and second bearings, respectively, such that the shaft has a predetermined amount of axial and radial play relative to the housing.

A metal biasing element is positioned between one of the shaft or the housing and one of the bearings. The biasing element initially urges the shaft to a preloaded position relative to the housing, wherein the first inner race and the second inner race are locked

into respective fixed positions to the shaft. The first outer race and the second outer race are locked into respective fixed positions to the housing to prevent axial and radial movement of each of the first inner race and the second inner race relative to the shaft and the first outer race and the second outer race relative to the housing, such that the shaft is locked in the preloaded position to prevent reciprocating axial and radial movement during motor operation.

A reciprocating pump is operatively connected to the shaft of the non-reciprocating motor for converting non-reciprocating motion of the shaft to reciprocating pumping motion.

The housing assembly, rolling elements, races, bearings, and shaft of the motor each have respective coefficients of thermal expansion that are selected so that the rolling elements, races, bearings, and shaft contract and expand during varying thermal conditions while remaining in their respective locked, preloaded position during motor operation due to the selected coefficients of thermal expansion.

The newly submitted claims therefore recite the combination of a non-reciprocating motor and a reciprocating pump, wherein the motor components are metal, and the coefficients of thermal expansion selected so that the metal motor components contract and expand during varying thermal conditions while remaining in their respective locked, preloaded position during motor operation due to the selected coefficients of thermal expansion.

Basis of Rejection of Previous Claims

The previously-submitted claims were rejected based principally on the Brown and

Fries Patents, of record. The Examiner concedes that Fries, alone, says nothing about selecting motor components with matching coefficients of thermal expansion in mind. Fries is therefore representative of many known motors that are designed to operate without regard to considerations such as the relative thermally-induced expansion and contraction of motor components during operation. Such motors are generally designed with sufficiently large tolerances to accommodate whatever thermal expansion and contraction takes place during and between operation. The Examiner cites the Brown reference as support for the conclusion that it would be obvious to combine Fries and Brown to arrive at the invention claimed by applicant.

Applicant has cancelled all previously-pending claims and has presented substantially-revised claims. Applicant therefore submits that the previous rejections are substantially mooted by the presentation of the new claims.

The Curtis Declaration

The Declaration of Douglas Curtis, attached, establishes that the claimed motor is both novel and unobvious in view of Fries and Brown. The claimed motor was derived as a result of successive failures to achieve a motor with a long operational life, and which operated during its life span without loosening of components due to thermal expansion. This is an important consideration in many applications where both a reliably long motor life and quiet motor operation are important considerations. Curtis Dec. at ¶ 2.

One of the significant applications of the claimed motor is operating a reciprocating

medical pump used for peritoneal dialysis. Peritoneal dialysis ("PD")is a treatment for patients with severe chronic kidney failure. Fluid is introduced into the abdomen, which draws out water, salts and waste products from the blood through diffusion. A catheter is inserted through the abdominal wall and used to introduce the fluid. One form of PD, continuous ambulatory peritoneal dialysis (CAPD), does not require a motor and pump. As the word "ambulatory" suggests, the patient can walk around with the dialysis solution in his or her abdomen. Another form of PD, continuous cycler-assisted peritoneal dialysis (CCPD), requires a machine called a "cycler" to fill and drain the abdomen, usually while the patient sleeps. CCPD is also sometimes called automated peritoneal dialysis (APD). The fact that the patient usually performs CCPD while sleeping requires a motor that is both reliable and quiet. Curtis Dec. at ¶ 3.

In designing a motor for this application, applicant first attempted to secure the motor components together using aluminum components connected together with two bolts extending through the end bell and housing. After a relatively short period of operation, the motor parts loosened, creating both component wear and an unacceptable noise level. Applicant increased the number of bolts to 4, with the same results. Curtis Dec. at ¶ 4 & 5.

Applicant then designed a motor with a steel housing and aluminum end bells connected with 4 bolts, with the same unacceptable results. In each case, the motor components loosened, reducing motor life and creating noise as the loosened parts contacted each other at a rapid rate. Curtis Dec. at ¶ 6.

Finally, applicant designed a motor with a steel housing, steel end bells, a steel shaft and steel bearings. The components were preloaded with a steel spring into a preloaded operating position and adhesively locked into the preloaded operating position. Curtis Dec. at ¶ 7.

This motor preload design enabled several market application advantages for miniature diaphragm pumps that are powered by it. These advantages include the ability to operate miniature diaphragm pumps at greater performance loads (pressure and/or vacuum) and under greater thermal delta environments while achieving exceptional operational life and fitting into a very small envelope size. Applicant has therefore been able to warrant its pumps configured with this motor design for 10,000 hours operation. No competitor of applicant that sells similar products provides such a warranty. In addition, most competitive pumps will specify a maximum ambient temperature of 40°C on their data sheets, whereas applicant specifies 50°C as a maximum ambient temperature for the claimed motor. Curtis Dec. at ¶ 8.

This product design with the now-claimed enhancement has enabled applicant to earn business in several market applications that required the above benefits over competitive offerings that did not thoroughly meet the customer's design and performance objectives. As a result, applicant earned revenue of $2.0M in 2007 and $2.3M in 2008 that is attributed to this specific motor design configuration, as presently claimed. Curtis Dec. at ¶ 9.

Previous pump motors used in the cycler had a service interval that required the

pump to be rebuilt or replaced at an unacceptably high frequency, requiring the pump and motor to be pulled out of service to be rebuilt. Accelerated reliability testing on the claimed motor has proven that the motor is good for the life of the cycler. In fact, the pumps are still on the fixture with no failures with over 10 years of accelerated life testing. This appears to be five times the life of motors not having the claimed design features. Curtis Dec. at ¶ 10.

The claimed motor is also less expensive and substantially quieter. Prior motors quickly developed a whine that could not be dampened with available sound abatement material. This is a serious drawback for a product that operates through the night while the user sleeps. The cycler is usually on a night stand next to the bed of the patient. The entire unit must be quiet for the patient and for his or her partner to sleep. Through the life test and periodic sound testing carried out to date, the claimed motor has not increased in sound level. Curtis Dec. at ¶ 11.

Another such application for the claimed motor is for portable oxygen concentrators. Due to the reduced size, weight, reliability and quietness, the claimed motor allows the device to be more portable while achieving performance and reliability requirements. Curtis Dec. at ¶ 12.

The Claimed Invention is Not Obvious in View of Fries and Brown

The Fries Patent discloses a submersible motor that has an electrically driven rotating mixer. The electric motor and hydraulic part are connected by a rotary shaft. The shaft end opposite from the hydraulic part is resiliently supported in a stator casing which surrounds the motor. The motor is conventional, and says nothing regarding the relative coefficients of thermal expansion of the various motor components. Curtis Dec. at ¶ 13.

The Brown Published Application discloses a torque motor, including a partial rotation drive suitable for use in a galvanometer scanner, where the rotor is supported within the stator and housing assembly on all ceramic ball bearings, including inner and outer races and bearing balls. The ceramic ball bearing assemblies and structural support elements have substantially equal coefficients of expansion through the use of matched expansion, nickel-iron alloy for the rotor shaft, stator, housing and other structural components which contact, locate, and support the inner and outer bearing races. The non-conductive bearings permit exclusion of any grounding conductor strap as between the rotor shaft and the housing. Curtis Dec. at ¶ 14.

The Brown Published Application is directed to a completely different problem than the claimed invention. In Brown, the primary goal is to achieve a reciprocating motor with a galvanometer bearing arrangement that can tolerate no gross dynamic changes in alignment:

> In galvanometer use, it is generally necessary to locate the axis of rotation

> within 1 micro-radian or less over very long periods of time, and over the full service temperature range. Also, the gyroscopic and other inertial load and rotor moments on the bearings must be resisted by a stiffness in the location and mounting of the bearings which generally prohibits the use of temperature-compensating springs of any sort. In fact, the inherent stiffness of the bearings themselves, while very high, is the source of the limiting axle-positioning errors in most cases. As a result, the complex, expensive, many-component art taught by these patents is entirely unsuitable for use in a galvanometer and other such rigorously precise rotary applications.

Brown Published Application, ¶ 0015. Curtis Dec. at ¶ 15.

These considerations have no place in the claimed invention. In particular, the claimed invention explicitly recites a biasing element such as a spring as an element of the invention, and not only does not "prohibit the use of temperature-compensating springs of any sort", but requires such a biasing element for its operation. In addition, the disclosure of the Brown Published Application is directed to a "partial rotation torque motor" used to move a scanner mirror. As such, the principal motivation to use "matched" components is to maintain the necessary degree of precision in the partial-rotation, reciprocating motor in the "1 micro-radian or less" range. In contrast, applicant's motivation was to design a non-reciprocating motor that, when subjected to severe reciprocating radial loading, as from a diaphragm pump, retains its parts in a fixed relation so that wear and noise are minimized. Curtis Dec. at ¶ 16.

In *Tec Air Inc. v. Denso Manufacturing Michigan Inc.*, 192 F.3d 1353 (Fed. Cir. 1999), the Federal Circuit stated in an analogous case that to establish a *prima facie* case of obviousness, one must show that "some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual

to combine the relevant teachings of the references." The Federal Circuit went on to say that there is no suggestion to combine if a reference teaches away from its combination with another source. "A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant . . . [or] if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant." Similarly, in *Winner International Royalty Corp. v. Wang*, 201 F.3d 1340,(Fed. Cir. 2000), the Federal Circuit held that "Although a reference need not expressly teach that the disclosure contained therein should be combined with another, the showing of combinability in whatever form, must nevertheless, be 'clear and particular.'"

Correctly understood, the Brown Published Application teaches away from adopting the practice of matching the coefficient of thermal expansion of various machine elements in the absence of the need to precisely control and locate the axis of rotation to a highly precise degree. Brown explicitly distinguishes applications having springs, Brown, ¶ 0014, such as applicant's invention, because whereas motors having springs can tolerate "dynamic uncertainty in the position of the axis of rotation ", no such uncertainty is possible in the reciprocating motor of Brown. *Id.*

Thus, one of skill in the art reading Brown would be directed away from matching the coefficient of thermal expansion of various machine elements in the absence of a need to precisely control dynamic uncertainty in the position of the axis of rotation. At a

minimum, one of skill in the art would not appreciate that the solution to the problem faced in Brown was also a solution to the different problem solved in the presently-claimed invention. There is nothing "clear and particular" in Brown that would prompt one of ordinary skill to adopt the Brown teaching to a distinctly different problem.

This principle was carried forward in *KSR International Co. V. Teleflex Inc.* 550 U.S. 398 (2007). In *KSR* the Supreme Court expressly overruled the Court of Appeals for the Federal Circuit's "teaching-suggestion-motivation" ("TSM") test for finding a claimed invention obvious and reaffirmed the Court's precedents regarding the obviousness of patents "based on the combination of elements found in the prior art" where there the combination "does no more than yield predictable results." Nevertheless, the Supreme Court in *KSR* cautioned against use of hindsight to combine references:

> A fact finder should be aware, of course, of the distortion caused by hindsight bias and must be cautious of arguments reliant upon *ex post* reasoning. See *Graham*, 383 U.S., at 36, 86 S.Ct. 684 (warning against a "temptation to read into the prior art the teachings of the invention in issue" and instructing courts to " 'guard against slipping into the use of hindsight' " (quoting *Monroe Auto Equipment Co. v. Heckethorn Mfg. & Supply Co.*, 332 F.2d 406, 412 (C.A.6 1964)))

550 U.S. 421.

KSR was also careful to note, notwithstanding its broad holding, that:

> As is clear from cases such as *Adams*, a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art. Although common sense directs one to look with care at a patent application that claims as

> innovation the combination of two known devices according to their established functions, it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does. This is so because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known.

550 U.S. 418-19.

> With these cautions in mind, the Supreme Court set out the following test:
>
> When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability.

550 U.S. 417.

Brown demonstrates that there was nothing "predictable" in matching coefficients of thermal expansion of all metal components to control noise, when Brown matched metal and ceramic components to maintain "the axis of rotation within 1 micro-radian or less over very long periods of time."

Applicant has amended the claims in response to the last office action, and has done so in a manner that clearly avoids the prior art. Fries and Brown do not render the claimed invention obvious, because the combination does not meet the test

Applicant submits that the arguments and amendments are sufficient to place the pending application in condition for allowance and respectfully requests a timely Notice of Allowance be issued for this matter. The Director is hereby authorized to charge any additional fees or any under payments which may be required for the above-referenced

application to Deposit Account No. 01-0265.

Respectfully submitted,

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